Universitat Autònoma de Barcelona

2020/2021

Microbiology

Code: 101953
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	FB	1	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Catalan is the most used language in the course but Spanish is also used.

Teachers

Isidre Gibert

José Antonio Domínguez Benítez

Prerequisites

Although there are no official prerequisites, it would be better for students to be familiar with microbiology concepts and have a good knowledge of the other subjects that are studied simultaneously during the first semester.

Objectives and Contextualisation

The course is mandatory and core of the Degree of Genetics. It introduces the student into the microbial world, giving a general vision of the microorganisms, in connection with other higher organisms, including plants and animals, and also with the different environments where they live, including the relations established between microorganisms and humans.

This course offers the basic concepts and competencies in Microbiology so that the student can go more into depth in the Microbiology field in the following years.

Objectives of the Course:

1. To identify and describe the different structures, and the composition of the prokaryotic cells.
2. To discover the metabolic versatility of the different groups of microorganisms.
3. To analyse the microbial population growth, and to discuss how to control it by chemical and physical methods, including antimicrobials.

4. To distinguish viruses based on their main characteristics, their life cycle, their relation with the host and their diversity.
5. To recognize the genomic variability of the microorganisms and to compare the main mechanism of exchange of genetic information between prokaryotes.
6. To discover the microbial diversity and to distinguish the main characteristics that defines each microbial group.
7. To describe the relations between the microorganisms with other organisms, including plants and animals, and with the environment where they live, including the interaction with humans.

Competences

- Apply scientific method to problem solving.
- Be able to analyse and synthesise.
- Be able to communicate effectively, orally and in writing.
- Be sensitive to environmental, health and social matters.
- Develop self-directed learning.
- Reason critically.
- Recognise and structurally and functionally describe the different levels of biological organisation, from macromolecules to ecosystems.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Learning Outcomes

1. Apply scientific method to problem solving.
2. Be able to analyse and synthesise.
3. Be able to communicate effectively, orally and in writing.
4. Be sensitive to environmental, health and social matters.
5. Describe microbial populational dynamics and the physical and chemical processes that control them.
6. Develop self-directed learning.
7. Identify microbial metabolic diversity and its relationship with different groups of microorganisms.
8. Reason critically.
9. Recognise the diversity of the world of microbes and identify the main groups that it is composed of.
10. Relate the components and basic structures of microorganisms with their functions.
11. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Content

THEORETICAL CONTENTS*

INTRODUCTION

Chapter 1. The microbial world.

The history and scope of microbiology. Discovering the microorganisms. Levels of organization. Differences between viruses and cellular organisms. Prokaryotic and eukaryotic organization. Groups and taxonomy of microorganisms.

PROKARYOTIC CELL: STRUCTURE AND FUNCTION

Chapter 2. The prokaryotic cell.

Size and morphology. Cytoplasm. Nucleus. Cytoplasm membrane.

Chapter 3. Prokaryotic cell envelope and motility.

Structure and function of the cell wall. Capsule and mucous envelops. Main motility mechanisms.

Chapter 4. Intracellular inclusions and differentiation forms.

Functional inclusions and storage. Endospores. Filamentous and mycelium. Spores and cists. Fructiferous bodies.

PHYSIOLOGY AND BACTERIAL METABOLISM

Chapter 5. Metabolism and metabolic diversity of bacteria.

Energy, Carbon and reduction power sources. Biosynthetic strategies. Energy caption. Groups of microorganisms according to their nutrition. Lithotrophy, organotrophy and phototrophy. Autrotrophy and heterotrophy.

Chapter 6. Respiration

Respiratory chains. Aerobic respiration. Inorganic, and facultative organic respiration. Anaerobic respiration.

Chapter 7. Fermentation.

General characteristics of fermentation. Final products and fermentation classification. Non-phosphorylation at substrate level fermentations. Syntrophism.

Chapter 8. Photosynthesis.

Photosyntheticpigments and photosynthetic systemsorganization. Photophosphorylation. Differences between anoxygenic and oxygenic photosynthesis.

MICROBIOAL GROWTH AND CONTROL

Chapter 9. The life cycle of prokaryotes.

Binary fission. Cellular division and control. Diversity in the cellular cycle in prokaryotes.

Chapter 10. Microbial growth and continuous culture of microorganisms.

Cellular growth and population growth. Interaction of the environmental factors in the growth. Microbial continuous culture concepts.

Chapter 11. Control of microbial growth by means of chemical agents.

Antimicrobials agents. Differences between antiseptics, disinfectants and chemotherapeutics agents. Antimicrobial resistance.

VIROLOGY

Chapter 12. Virus's morphology, structure and composition.

Concept of viruses. Viral components: nucleic acids, enzymes and others. Envelope structure. Morphology: icosahedral, helix, mixed and complex symmetry. Techniques for viruses study.

Chapter 13. Relationship between viruses and the host cell.

Viral cycle: step growth. Adsorption and penetration. Replication of the genome. Replication. Assembly and release of the viruses. Virulent and attenuated bacteriophages. Lytic and lysogenic cycles: regulation. Potential effects of the viruses' multiplication in the host.

Chapter 14. Classification and virus diversity.

Classification criteria. Nomenclature. Baltimore classification. Bacteriophages, animal and plant viruses. Other subcellular infectious agents.

BACTERIAL GENETICS AND GENOMICS

Chapter 15. The genome of prokaryotic organisms.

Genome structure, genes and operons. Size, topology and number of chromosomes. Replication, transcription and translation. Extra-chromosomal material. Plasmids and mobile genetic elements.

Chapter 16. Mutagenesis and genomic integrity.

Spontaneous and induced mutations. The Ames test. Selection of mutants and phenotypic expression. Mechanisms maintaining genomic integrity.

Chapter 17. Mechanisms of horizontal gene transfer: Conjugation, transformation and transduction.

Plasmid conjugation. Transfer of genetic material by means the F plasmid. Natural and artificial transformation. Status of competence and DNA incorporation. General and specialized transduction. Role of recombination.

Chapter 18. Genetic engineering and biotechnology.

Basic principles of biotechnology and the contribution of Microbiology. Restriction endonucleases. Techniques for cloning and directed mutagenesis. Expression of cloned genes and production of recombinant proteins. Genetic engineering products.

MICROBIAL EVOLUTION, DIVERSITY AND ECOLOGY

Chapter 19. Prokaryote evolution and taxonomic diversity.

Polyphasic approach of species concept for prokaryotes. Classic and molecular taxonomy. Phylogenetic diversity. Principles of phylogenetic classification. The origin of life and the endosymbiotic theory. Archaea vs. Bacteria.

Chapter 20. Functional diversity.

The definition of functional diversity. Diversity of quimiolitotrophic and phototrophic bacteria. Main extremophile microorganisms.

Chapter 21. The microorganisms in the environment and biogeochemical cycles.

Microbial ecology basic concepts. Environments and microenvironment. Surface colonization and biofilm formation. The microorganisms as agents of geochemical changes. Main microorganisms involved in the biogeochemical cycles.

Chapter 22. Associations among microorganisms.

Microbial symbioses. Basic concepts and main groups involved. Intra and inter-population relationships. Interactions with plants and animals. Normal microbiome.

Chapter 23. Host-pathogen interaction.

Pathogens vs. parasites and their interaction with the host. Mechanisms of bacterial pathogenicity and virulence factors. Host defence mechanisms. Epidemiology and control of human infectious diseases.

PROBLEM CONTENTS*

- Microscope image analysis. Morphologies and microbial structures identification. Fixation and stain.

- Culture and isolation of bacteria. Bacteria identification and typing.

- Counting microorganisms and growth curves. Antibiograms.

- Solving problems in applied and basic virology. Application of bacteriophages.

- Solving bacterial genetics and genomics problems.

- Solving applied microbiology problems. Basic techniques in recombinant DNA and genetic engineering.

- Taxonomic methods in microbial systematics and description of new species.

- Epidemiology and control of infectious diseases.

* Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

Methodology and learning activities

The teaching methodology includes two types of differentiated activities. The students will have to combine the learning activities scheduled in order to achieve the previous competences mentioned. The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Participative theoretical sessions: The students have to acquire the scientific and technological knowledge of the subject following the lectures, and expanding and confronting the main ideas of the topics autonomously as a personal work. At the beginning of the course the student will receive the calendar with the topics that we will be discussed, and also the references. The student should use this material to prepare the theory sessions. The professor using visual material will explain the content of different topics. An active participation of all students in the discussion of different topics will be promoted. For some classes the flipped classroom methodology will be used in which students engage with lectures or other materials prior to class, and answer an online questionnaire (Moodle). Based on the student answers, the professor prepares the session, adjusting his explanation to the answers obtained.

Problem-solving sessions: These are basically active learning sessions with a reduced number of students. The objectives are: a) to work methodological aspects; b) to facilitate the understanding of the knowledge explained in the theory sessions; c) to teach student how to integrate the knowledge and how to solve microbiological basic problems; d) acquire the necessary skills to carry out bibliographic searches, read texts and prepare public presentation of their results, e) create skills for teamwork. During the course the student will receive material with problems to solve, either individually or in groups. In addition, they will also receive a course schedule with the approximate content of each session, which will indicate the bibliography they will need to consultand the relation of each session with the topics covered in the theoretical classes.Oral presentations and/or delivery of written materials about some specific topics could be scheduled. This could include topics related to the problem-based activities or a real scientific study.

As supervised activities and to support the learning activities indicated above, individual and collective mentoring will be possible.

To follow adequately the course, the student will have access to all the materials used in the sessions via Moodle (PowerPoint presentations, bibliographic references, etc.) and supplementary materials (glossary of terms, online self-assessment tests, etc.).

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Participative theoretical sessions	30	1.2	1, 5, 7, 8, 9, 10, 3, 2, 11
Problem-solving sessions and active learning activities	14	0.56	1, 5, 7, 8, 9, 10, 3, 2, 11

Type: Supervised			
Mentoring	3	0.12	2
Type: Autonomous			
Individual study	40	1.6	1, 4, 5, 6, 7, 8, 9, 10, 2, 11
Literature search and individual reading	15	0.6	1, 6, 8, 2, 11
Preparing reports in collaborative groups	10	0.4	1, 6, 8, 3, 2, 11
Solving problems	34	1.36	1, 4, 5, 6, 7, 8, 9, 10, 2, 11

Assessment

The assessment of the subject will be individual and continuous, and it will be done through different activities:

1. Assessment of the theoretical contents (50% of the overall grade) by means of two written tests that can count on short answer questions, multiple choice and/or true/false questions.
2. Assessment of the problem contents (20% of the overall grade) by means of two written tests that can count on problem-solving questions.
3. Assessment of active learning activities (30% of the overall grade). The assessment of this part will be done considering the classroom problem solving activities (individually or in groups) through short oral presentations.

During the course two midterm exams will be scheduled which will include the theoretical contents and problem-solving activities. The weight of each of the two midterm exams is of 35% of the final grade each. Each of the two midterm exams requires a minimum grade of 5 points in each module in order to pass them.

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

The assessment of the active learning through individual and group activities will be performed during the whole course. In the following table the distribution of the grades is indicated.

Module	1er test	2nd test	Final grade
Theory contents	25	25	50
Problems contents	10	10	20
Active learning activities	30		30
Total	-		100

General issues

Overall, in order to successfully complete this course, the student must get a global final grade >=5.0 points and to pass each of the main activities in each module. The failed midterm exams can be reassessed in a final exam. To pass the

final exam students should obtain a minimum grade of 5. The students that have not attended the midterm exams, or want to obtain a higher grade can reassess the entire subject in the final exam. The student who takes this exam renounces the previous notes and therefore, the grade of this test will be the one that will prevail in the final grade even if it is lower than the ones obtained in the midterm exams.

To be eligible for the retake process, the student should have been previously evaluated in a set of activities equalling at least two thirds of the final score of the course or module. Thus, the student will be graded as "Not Evaluable" if the weight of all conducted evaluation activities is less than 67% of the final score.

The students that cannot attend to an exam due to justified andunpredictable causes (disease or accident, death of a relativeof first or second degree, sport competition for elite athletes, etc.) and present the corresponding official certification to the degree coordinator during the 48 hours after the sessionmissed will have the opportunity to do the test in another date. The coordinator will be responsible for the new date decision together with the professor responsible of the subject.

On the other hand, according to the regulations of the UAB, those enrolled in the subject for the second time, do not have to do again activities for modules 2 and 3, if they have passed those modules in previous years. This exemption will be valid for a period of three additional enrolments.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Active learning activities	30%	0	0	1, 4, 6, 8, 3, 2, 11
Theoretical and problems, 2nd Midterm exam (Written test)	35%	2	0.08	1, 4, 5, 6, 7, 8, 9, 10, 3, 2, 11
Theoretical and problems,1st Midterm exam (Written test)	35%	2	0.08	1, 4, 5, 6, 7, 8, 9, 10, 3, 2, 11

Bibliography

Text Books:

-Martín A, Béjar V, Gutiérrez J, Llagostera M, Quesada E. 2019. Microbiología Esencial. 1ª Edición. ISBN-13: 9788498357868. Editorial Medica Panamericana S.A.

-Rozman C, Cardellach F. Medicina Interna. 2016. 18ª ed. Elsevier. ISBN 9788490229965

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- Cann, Alan J. 2015. Principles of molecular virology. 6th ed. ISBN 9780128019467. Elsevier Academic Press

-Willey, J, LM Sherwood, CJ Woolverton. 2008. Microbiología de Prescott, Harley y Klein. 7ª ed. MacGraw-Hill. ISBN: 978-8448168278.

-Ausina V, Moreno S. 2006. Tratado SEIMC de Enfermedades Infecciosas y Microbiología Clínica. Editorial Panamericana. ISBN 8479039213

Websites:

https://www.semicrobiologia.org/

http://www.asm.org/

http://www.microbeworld.org/

http://microbewiki.kenyon.edu/index.php/MicrobeWiki

http://serc.carleton.edu/microbelife/

http://www.cellsalive.com/

http://commtechlab.msu.edu/sites/dlc-me/

http://commtechlab.msu.edu/sites/dlc-me/zoo/

http://www.microbiologia.com.ar/

Online Blogs:

- Esos pequeños bichitos http://weblogs.madrimasd.org/microbiologia/
- Small things considered http://schaechter.asmblog.org/schaechter/
- Curiosidades de la Microbiología http://curiosidadesdelamicrobiologia.blogspot.com/